

CLAIMS

What is claimed is:

1. A system for conveying a string of packaging cushions comprising:

a machine capable of manufacturing the string of packaging cushions, wherein the machine defines a manufactured cushion outlet elevation;

a conveyor adapted to transport the string of packaging cushions, the conveyor having an inlet end capable of receiving the string of packaging cushions and an outlet end capable of delivering the string of packaging cushions, wherein the inlet end of the conveyor is at an elevation higher than the manufactured cushion outlet elevation; and

at least one pair of rolls forming a nip and adapted to lift the string of packaging cushions from the machine through the nip to the conveyor inlet elevation.
2. The system of claim 1 wherein the inlet end of the conveyor is at least about 4 feet above the manufactured cushion outlet elevation.
3. The system of claim 1 wherein the conveyor comprises a plurality of conveyor belts.
4. The system of claim 1 wherein:

a gap region is defined between the front and rear nips; and

the rear pair of rolls are adapted to rotate at a speed faster than the rotational speed of the front pair of rolls to tension the string of packaging cushions in the gap region and separate the string of packaging cushions into a leading string segment and a trailing string segment in the gap region.

5. The system of claim 1 wherein the at least one pair of rolls comprises a front pair of rolls forming a front nip and a rear pair of rolls forming a rear nip downstream from the front nip, the front and rear rolls being adapted to move the string of packaging cushions through the front and rear nips to the conveyor.

6. The system of claim 5 further comprising a plunger moveable between an engaged position and a disengaged position, wherein:

in the engaged position the plunger is:

between the front and rear pairs of rolls;

extends through a line formed between the front and rear nips; and

is adapted to separate the string of packaging cushions; and

in the disengaged position the plunger does not extend through the line.

7. The system of claim 6 wherein the plunger comprises a blunt end for separating the string of packaging cushions.

8. The system of claim 1 wherein:

the at least one pair of rolls comprises a top roll and a bottom roll;

at least one of the top and bottom rolls are adapted to deform as the string of packaging cushions passes through the nip formed by the rolls.

9. The system of claim 1 wherein the at least one pair of rolls comprises resilient foam.

10. The system of claim 1 wherein:

the at least one pair of rolls comprises a top roll and a bottom roll;

the top and bottom rolls comprise resilient foam;

the resilient foam of the top roll is more dense than the resilient foam of the bottom roll.

11. The system of claim 1 wherein:

the conveyor comprises two or more conveyor sections;

at least one of the conveyor sections is moveable between:

a conveyor-section open position to create an intermediate outlet between the inlet and outlet ends of the conveyor and establish an intermediate flow path for the string of packaging cushions along the conveyor from the conveyor inlet end through the intermediate outlet; and

a conveyor-section closed position in which the intermediate outlet is closed to establish a primary flow path for the string of packaging cushions past the intermediate outlet location.

12. The system of claim 11 wherein the at least one of the conveyor sections comprises:

an upstream end moveable to create the intermediate outlet; and

a hingedly supported downstream end downstream from the upstream end of the at least one of the conveyor sections.

13. The system of claim 11 wherein the at least one of the conveyor sections comprises:

a downstream end moveable to create the intermediate outlet; and

a hingedly supported upstream end upstream from the downstream end of the at least one of the conveyor sections.

14. The system of claim 11 wherein:

the at least one pair of rolls comprises a front pair of rolls forming a front nip and a rear pair of rolls forming a rear nip, the front and rear rolls being adapted to move the string of packaging cushions through the front and rear nips to the conveyor; and further comprising:

a plunger moveable between an engaged position and a disengaged position, wherein:

in the engaged position the plunger is:

between the front and rear pairs of rolls;

extends through a line formed between the front and rear nips; and

is adapted to separate the string of packaging cushions into a leading string segment and a trailing string of packaging cushions; and

in the disengaged position the plunger does not extend through the line; and

a controller adapted to control the operation of the plunger and the moveable at least one conveyor section in coordinated sequence to deliver the string of packaging cushions along the desired primary or intermediate flow paths.

15. The system of claim 14 wherein the controller is adapted to control the operation of the front and rear pair of rollers in coordinated sequence with the operation of the plunger and the moveable at least one conveyor section.

16. The system of claim 14 wherein:

the at least one of the conveyor sections is moveable to the conveyor-section open position in response to a conveyor-section open signal;

the at least one of the conveyor sections is moveable to the conveyor-section closed position in response to a conveyor-section close signal;

the plunger is moved to the engaged position in response to a plunger-engagement signal; and

the controller is adapted to send the plunger engagement signal and the conveyor-section open and close signals in coordinated sequence so that the intermediate outlet is created or closed in time for a trailing string of packaging cushions to travel a flow path selected from the primary and intermediate flow paths.

17. The system of claim 1 wherein:

the conveyor comprises:

a first moveable conveyor section moveable between:

a first conveyor-section open position to create a first intermediate outlet between the inlet and outlet ends of the conveyor and establish a first intermediate flow path for the string of packaging cushions along the conveyor from the conveyor inlet through the first intermediate outlet; and

a first conveyor-section closed position in which the first moveable conveyor section is closed so that the string of packaging cushions passes the first intermediate outlet position;

a second moveable conveyor section moveable between:

a second conveyor-section open position to create a second intermediate outlet between the inlet and outlet ends of the conveyor; and

a second conveyor-section closed position in which the second moveable conveyor section is closed so that the string of packaging cushions passes the second intermediate outlet position, wherein:

a second intermediate flow path for the string of packaging cushions along the conveyor from the conveyor inlet past the first intermediate outlet position and through the second intermediate outlet is established when the first moveable conveyor section is in the closed position and the second moveable conveyor section is in the open position; and

a primary flow path for the string of packaging cushions along the conveyor from the conveyor inlet past the first and second intermediate outlet positions is established when the first and second moveable conveyor sections are in the closed positions;

the at least one pair of rolls comprises a front pair of rolls forming a front nip and a rear pair of rolls forming a rear nip, the front and rear rolls being adapted to move the string of packaging cushions through the front and rear nips to the conveyor; the system further comprising:

a plunger moveable between an engaged position and a disengaged position, wherein:

in the engaged position the plunger is:

between the front and rear pairs of rolls;

extends through a line formed between the front and rear nips; and

is adapted to separate the string of packaging cushions into a leading string segment and a trailing string of packaging cushions; and

in the disengaged position the plunger does not extend through the line;

and

a controller adapted to control the operation of the plunger and the first and second moveable conveyor sections in coordinated sequence to deliver the string of packaging cushions along the desired primary, first intermediate, and second intermediate flow paths.

18. The system of claim 17 further comprising:

a first hopper corresponding to the first intermediate outlet and adapted to receive a string of packaging cushions passing along the first intermediate flow path to establish a given level of cushions in the first hopper; and

a second hopper corresponding to the second intermediate outlet and adapted to receive a string of packaging cushions passing along the second intermediate flow path to establish a given level of cushions in the second hopper; wherein:

the controller is adapted to control the operation of the plunger and the movement of the first and second moveable conveyor sections in coordinated sequence to deliver the string of packaging cushions along the desired primary, first intermediate, and second intermediate flow paths in response to the given levels of cushions in the first and second hoppers.

19. A method of conveying a string of packaging cushions using the system of claim 1, the method comprising:

manufacturing a string of packaging cushions using the machine;

lifting the string of packaging cushions from the manufactured cushion outlet elevation of the machine through the nip of the at least one pair of rolls to the conveyor inlet elevation of the conveyor; and

transporting the string of packaging cushions along the conveyor.

20. The method of claim 19 wherein the string of packaging cushions comprises a string of air-filled dunnage cushions.

21. A machine for separating a string of packaging cushions, the machine comprising:

a front pair of rolls comprising an upper front roll and a lower front roll forming a front nip between the upper and lower front rolls, the front nip being adapted to pass the string of packaging cushions through the front nip;

a rear pair of rolls comprising an upper rear roll and a lower rear roll forming a rear nip between the upper and lower rear rolls, the rear nip being adapted to pass the string of packaging cushions through the rear nip; and

a plunger moveable between an engaged position and a disengaged position, wherein in the engaged position the plunger is between the front and rear pairs of rolls and extends through a line formed between the front and rear nips to separate the string of packaging cushions into a leading string segment and a trailing string of packaging cushions, and in the disengaged position the plunger does not extend through the line.

22. The machine of claim 21 wherein the rear nip is no farther from the front nip than the length of three of the packaging cushions in the string of packaging cushions.

23. The machine of claim 21 wherein the rear nip is no farther from the front nip than the length of two of the packaging cushions in the string of packaging cushions.

24. The machine of claim 21 wherein the rear nip is no farther from the front nip than the length of one of the packaging cushions in the string of packaging cushions.

25. The machine of claim 21 wherein at least one of the rolls of the front pair of rolls and at least one of the rolls of the rear pair of rolls are adapted to deform as said string of packaging cushions pass through the corresponding front and rear nips.

26. The machine of claim 21 wherein at least one of the rolls of the front pair of rolls and at least one of the rolls of the rear pair of rolls comprises resilient foam.

27. A method of separating a string of packaging cushions using the machine of claim 21; the method comprising:

passing a string of packaging cushion through the front nip of the front pair of rolls;

passing the string of packaging cushions through the rear nip of the rear pair of rolls; and

moving the plunger to the engaged position to separate the string of packaging cushions into a leading string segment and a trailing string of packaging cushions.

28. The method of claim 27 wherein:

the string of packaging cushions comprises a string of air-fill packaging dunnage cushions defining perforations between at least two adjacent cushions; and

the plunger in the engaged position separates the string of packaging cushions at the perforations.

29. A machine for lifting and releasing a string of packaging cushions at a desired elevation, the machine comprising:

a pulley having a given pulley elevation;

a front roller at an elevation higher than the given pulley elevation;

an endless belt encircling the pulley and the front roller; and

a clip attached to the belt, wherein:

the clip is adapted to hold one end of the string of packaging cushions as the string is lifted by the belt to the elevation of the front roller; and

the clip is adapted to release the string upon application of a given release tension to the clip; and

a rear roller opposing the front roller and spaced sufficiently close to the front roller to obstruct the passage of a cushion of the string of packaging cushions between the front and rear rollers, wherein the endless belt and clip are adapted to pass between the front and rear rollers so that the obstruction of the passage of the string of packaging cushions causes the application of the given release tension to the clip to release the string of packaging cushions at the desired elevation.

30. The machine of claim 29 wherein:

the front roller defines a groove around the circumference of the front roller; and

the endless belt is within the groove of the front roller.

31. The machine of claim 29 further comprising a top roller forming a front nip with the front roller, the front and top rollers cooperating to move the string of packaging cushions through the front nip to the rear roller.

32. The machine of claim 29 further comprising an upper roller forming a rear nip with the rear roller, the upper and rear rollers cooperating to move the string of packaging cushions through the rear nip.

33. The machine of claim 29 further comprising:
a top roller forming a front nip with the front roller; and
an upper roller forming a rear nip with the rear roller, wherein:
the front and top rollers cooperate to move the string of packaging cushions through the front nip to the rear nip; and
the upper and rear rollers cooperate to move the string of packaging cushions through the rear nip.

34. The machine of claim 33 wherein the surface of the rear roller is no farther from the surface of the front roller than the width of a cushion of the string of packaging cushions.

35. The machine of claim 29 wherein the clip comprises a magnet adapted to oppose a metal member to clasp an object between the magnet and the metal member.

36. The machine of claim 35 wherein:
the magnet is attached to a flap;
the flap is attached to the endless belt; and
the metal member is affixed to the endless belt opposite the magnet.

37. The machine of claim 35 wherein:
the metal member is attached to a flap;
the flap is attached to the endless belt; and
the magnet is affixed to the endless belt opposite the metal member.
38. The machine of claim 29 wherein the clip is attached to the belt by a tether.
39. A system for conveying a string of packaging cushions comprising:
a machine capable of manufacturing the string of packaging cushions, wherein the machine defines a manufactured cushion outlet elevation;
a bottom conveyor adapted to transport the string of packaging cushions, the bottom conveyor having an inlet end capable of receiving the string of packaging cushions and an outlet end capable of delivering the string of packaging cushions, wherein the inlet end of the conveyor is at an elevation higher than the manufactured cushion outlet elevation; and
a first top conveyor forming a first nip with the bottom conveyor and adapted to cooperate with the bottom conveyor to lift the string of packaging cushions from the machine to the conveyor inlet end and through the first nip.
40. The system of claim 39 further comprising a second top conveyor downstream from the first top conveyor, the second top conveyor forming:
a second nip with the bottom conveyor adapted to pass the string of packaging cushions through the second nip; and
a gap region between the first and second top conveyors, wherein the second top conveyor in the engaged position is adapted to rotate at a speed faster than the rotational speed of the first top conveyor to separate in the gap region the string of packaging cushions into a leading string segment and a trailing string of packaging cushions.

41. The system of claim 40 wherein the second top conveyor is moveable between an engaged position in which the second top conveyor forms the second nip and a disengaged position in which the second top conveyor is spaced apart from the bottom conveyor to not contact the string of packaging cushions.

42. A system for conveying a string of packaging cushions comprising:

a machine capable of manufacturing the string of packaging cushions, wherein the machine defines a manufactured cushion outlet elevation;

a conveyor adapted to transport the string of packaging cushions, the conveyor having an inlet end capable of receiving the string of packaging cushions and an outlet end capable of delivering the string of packaging cushions, wherein the inlet end of the conveyor is at an elevation higher than the manufactured cushion outlet elevation; and

at least one roll forming a nip between the roll and the conveyor and adapted to cooperate with the conveyor to lift the string of packaging cushions from the machine to the conveyor inlet and through the nip.